NORTH CENTRAL FOREST EXPERIMENT STATION

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APPLICATION DATE AFFECTS HERBICIDE TOLERANCE OF HYBRID POPLARS

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ABSTRACT. — Several herbicides — glyphosate (Roundup), Linuron (Lorox), pronamide (Kerb), and dichlobenil (Casoron)—controlled weeds in a 1-year-old *Populus* plantation and did not seriously injure the trees when applied in early spring or late fall. Casoron was most effective but is expensive.

KEY WORDS: Weed control, intensive culture, plantation establishment.

To help meet the rising demand for wood products, we have been exploring new methods to grow trees faster. One such new method is the short rotation intensive culture (SRIC) plantation, which can produce significantly more fiber than natural stands. The SRIC system uses genetically improved stock together with agronomic cultural practices including site preparation, weed control, fertilization, and irrigation to grow large amounts of fiber.

One problem encountered during the first several years in SRIC plantations is competition by weeds for water, light, and nutrients. Herbicides are one means to control weeds in hardwood tree plantations.[1,2] Common agronomic practice involves applying herbicides either in the fall or spring before planting to kill perennial weeds or inhibit their development during the growing season. Additional weed control is needed in SRIC plantations until the tree crowns close. Herbicides applied after the trees are planted unavoidably contact the trees and may cause damage.[3]

Trees are generally more susceptible to herbicides during the period of active growth—from spring budbreak to fall bud-set—than they are during the dormant period. This study was conducted to determine how early in the fall and how late in the spring herbicides could be applied in a 1-year-old hybrid poplar plantation without significantly reducing either tree growth or survival. We assessed the effectiveness of various spray dates in terms of fall weed control (especially quackgrass) and tree injury in both fall and spring tests.

METHODS

The study site was located in an intensively cultured *Populus* plantation at the Harshaw Forestry Research Farm 17 km west of Rhinelander, Wisconsin. Site preparation included moldboard plowing and disking in the fall of 1979, a repeat disking in May 1980, and applying linuron (Lorox)[4] at 2.2 kg active ingredient per hectare (kg ai/ha) with a boom sprayer

[1]*Bey, Calvin F; Williams, Robert D. Weed control in black walnut plantations. Res. Note NC-203. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1976. 4 p.*

[2]*Williams, Robert D.; Krajicek, John E. The effect of four herbicides on the survival and growth of nine hardwood species. Res. Note NC-206. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1976. 4 p.*

[3]*Netzer, Daniel A.; Noste, Nonan V. Herbicide trials in intensively cultured* Populus *plantations in northern Wisconsin. Res. Note NC-235. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1978. 4 p.*

[4]*Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

in the spring. The area was then planted with 20-cm long unrooted, presoaked hardwood cuttings of clone NC-9922 (*Populus* spp.) at a 1 x 1 m spacing. Presoaking consisted of soaking the bottom 10 cm of the cuttings in water at room temperature (about 15°C) for 1 week prior to planting. The parentage of NC-9922 is unknown, but it appears nearly identical to NE-252 (NC-5334) *P. deltoides* Marsh. var. *angulata* x *P. trichocarpa* Torr. et Gray. Two separate herbicide tests were conducted in the fall and spring following the first growing season. The tests included 1,440 trees in a randomized complete block design with two replications. Plot size was 4 x 5 m with trees spaced 1 x 1 m for 20 trees per plot. Plots treated with Casoron had an additional 2 m untreated border to buffer adjacent plots. Before treatment, 198 permanent sample trees were selected from both tests and measured for height. Nine sample trees were selected and flagged in each plot of 20 trees. To reduce initial variation, selected trees were those most uniform in height. To the extent possible, trees were selected from the center of each plot, to minimize possible influence from adjacent plots.

Liquid and wettable powder herbicides were applied with a nitrogen pressurized two-nozzle hand sprayer at a height approximately 0.5 m above the ground and covering an area 1 m wide. The lower 0.3 m of the tree stem and some lower lateral branches were intentionally sprayed to simulate boom spraying. Dichlobenil (Casoron) granular pre-emergent herbicide was spread as evenly as possible by hand. All control plots were kept weed-free by hoeing during the entire growing season.

Fall Treatments

Treatments were glyphosate (Roundup) at 1.1 and 2.2 kg ai/ha; pronamide (Kerb) 1.1 kg ai/ha; dichlobenil (Casoron) 4.5 kg ai/ha; and hand-hoed control plots. Treatments were applied October 7, October 20, and November 10, 1980; Roundup 1.1 was omitted from the November 10 treatment. The earliest treatment date (October 7) was at least 1 month after bud-set for this clone. Total tree height was measured in September 1980 and again on August 31, 1981.

To determine degree of weed control, weed densities were visually estimated on June 8, 1981 after the tree leaves had flushed but before the crowns had closed. Weed density was rated as percent of cover in a 0.3 m radius around each sample tree. Special attention was paid to quackgrass because of its predominance in the study area.

Herbicide injury based on leaf curl and discoloration along with abnormalities in terminal and lateral buds was also observed on June 8. Percent of trees injured out of the total of 40 trees in the two replications of each treatment were recorded.

Spring Treatments

Treatments were Roundup 1.1 kg ai/ha; Roundup 2.2 kg ai/ha; Roundup 2.2 kg ai/ha with a 1 week delayed application of Lorox (pre-emergent herbicide) at 2.2 kg ai/ha; Roundup 2.2 kg ai/ha mixed with Lorox 2.2 kg ai/ha; Casoron 4.5 kg ai/ha; and hand-hoed control plots. Treatments were applied April 29, May 15, June 4, and June 23, 1981. Casoron was applied on only two early dates, April 15 and May 15, since it is only effective during cool weather.

The entire study area was mowed and raked in mid-April to keep dead weeds from intercepting herbicide during application and interfering with Lorox and Casoron activity. Plots were not remowed during the rest of the growing season as natural weed growth encroached.

For postleaf-flush applications, the number of leaves on the developing terminal shoot were counted to provide an index of the stage of tree growth. All leaves with a measured midrib of 5 cm or longer were counted.

Tree survival, total height, and number of trees injured by herbicide were recorded on August 31, 1981. Criteria for tree injury was the same as used for the fall treatments. No assessment was made of the effect of spring-applied herbicides on weed control.

RESULTS

Fall Treatments

Casoron was most effective in controlling weeds on all application dates (table 1). The October 7 Roundup treatments gave good control of quackgrass but failed to control other weeds. Later Roundup applications were less effective on quackgrass but gave good control on other weeds. Kerb 1.1 only controlled grasses.

None of the fall-applied herbicides killed any trees. However, Roundup 2.2 applied on October 7 injured 90 percent of the trees (fig. 1) and significantly ($p = 0.05$) reduced tree height growth (fig. 2). Roundup 1.1 had no significant effect on tree height growth but did injure 45 percent of the trees when applied October 7.

Table 1.—*Weed cover observed on June 8, 1981 following fall application of herbicides*

Herbicide	Rate kg ai/ha	Application Date 10/7/80	10/20/80	11/10/80
		Percent		
Control		0	[1]—	—
Kerb	1.1	26-50	51-75	76-100
Roundup	1.1	76-100	76-100	—
Casoron	4.5	0	0	26-50
Roundup	2.2	51-75	76-100	51-75

[1]— Treatment not tested.

Spring Treatments

As with the fall applications, none of the herbicides killed trees. However, substantial tree injury occurred from Roundup 2.2 applied on June 4 and from all herbicides applied on June 23 (fig. 1). Few leaves had flushed up through May 15, so herbicide applied before that date did not contact leaves. By June 4 and June 23, however, trees had 8 and 16 leaves, respectively, and this related to increased injury of the trees.

Spring application date had a highly significant effect upon tree height (fig. 2), but no significant differences were found between herbicides or for the interaction between herbicide and date. Tree heights of the two June application dates were significantly less than either the first two dates or the control and differed significantly from each other.

DISCUSSION

Herbicides applied between October 20 and May 15 did not significantly injure trees or reduce height

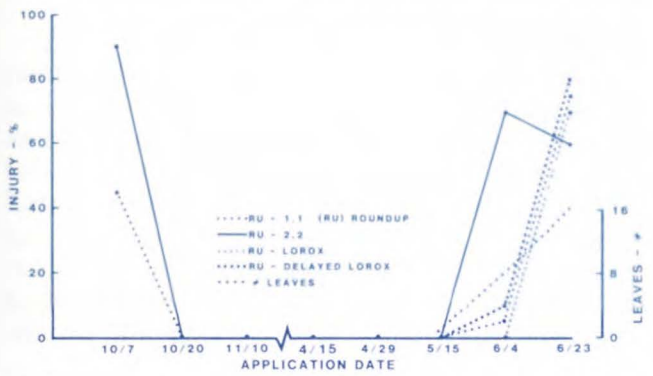


Figure 1.—*Number of leaves and associated tree injury as related to herbicide and application date.*

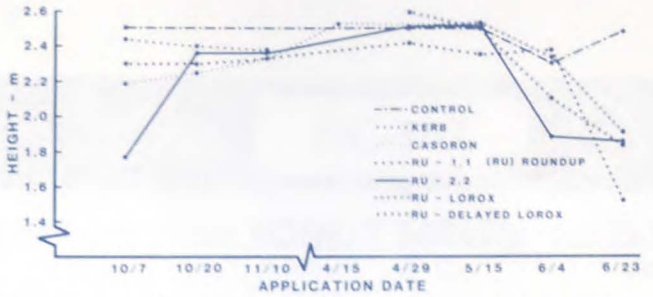


Figure 2.—*Two-year-old tree height as related to herbicide and application date.*

growth. Treatments applied earlier in the fall or later in the spring caused various amounts of injury and reduced height growth depending upon the herbicide and application rate.

Casoron controlled weeds well with no injury to *Populus*, but it costs $580/ha so is prohibitively expensive for large plantations. Also, Casoron's effectiveness is governed by soil temperature (which affects its chemical activity), thus limiting the period that it can be applied to cool seasons.

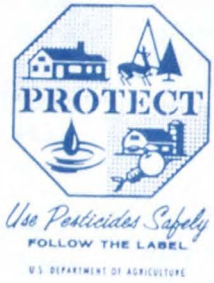
Roundup is cheaper to use—averaging about $68/ha for a 1.1 kg/ha application rate. When applied after October 20 in the fall or before May 15 in the spring, tree height growth was no different from Casoron. However, Roundup applied in the fall proved less effective in weed control, and it injured trees when applied too early in the fall or too late in the spring. Kerb appears promising; the earliest fall application gave moderately good weed control, no trees were injured on any of the application dates, and it costs only $22/ha.

Herbicide injury increased as the number of leaves on the developing terminal shoot increased. Number of leaves may eventually be a better indicator than date for determining when herbicides may be safely applied to *Populus* plantations in the spring. Further testing of application dates for various herbicides and physiological stage of the trees should help to pinpoint the period that herbicides can be safely applied in SRIC plantations. This knowledge can help to increase SRIC yields by allowing better plantation establishment.

PESTICIDE PRECAUTIONARY STATEMENT

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.



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